

synthetic image representative of an image acquired by the machine vision inspection system,  
and

an input portion for receiving CAD data representative of at least a  
portion of at least one object inspectable by the machine vision inspection system;

a hardware component simulation system, comprising:

a first portion operable to represent at least a current lens system of the  
machine vision inspection system, including a limited depth of field of the lens system, and

a second portion operable to represent a current state of at least the  
relative position of the lens system and the portion of at least one object inspectable by the  
machine vision inspection system;

a communication interface portion connected to exchange control and data  
signals between the user interface and the hardware component simulation system; and

a control instruction generating portion;

wherein the off-line programming system is operable to:

generate a current focus-dependent synthetic image of at least the  
portion of at least one object inspectable by the machine vision inspection system, including  
focus effects related to the limited depth of field of the lens system, based on at least two of a  
current state of the user-alterable control elements, the current lens system representation of  
the first portion and the current state representation of the second portion;

display the current focus-dependent synthetic image in the image  
display portion of the user interface; and

generate at least one control instruction usable in an inspection  
program for the at least one object inspectable by the machine vision inspection system,  
based at least partially on the current state of the user-alterable control elements.--

--46. The off-line programming system of claim 45, wherein the at least one control instruction usable in an inspection program determines that a first part of the at least one object inspectable by the machine vision inspection system will have discernably better focus in an image provided by the machine vision inspection system and that a second part of the at least one object inspectable by the machine vision inspection system will discernably poorer focus in that image provided by the machine vision inspection system.--

--47. The off-line programming system of claim 45, wherein the at least one control element that affects the focus of the synthetic image appears and operates substantially similarly to a control element included in a user interface of the machine vision inspection system for affecting the focus of the machine vision inspection system.--

--48. The off-line programming system of claim 45, wherein the at least one control element that affects the focus of the synthetic image comprises at least one of a) a focusing control element operable on the synthetic image representative of an image acquired by the machine vision inspection system and b) a control element for providing manual motion control.--

--49. The off-line programming system of claim 45, wherein the representation of at least a current lens system of the machine vision inspection system includes a representation of a plurality of lenses usable as the current lens system of the machine vision inspection system.--

--50. The off-line programming system of claim 45, wherein the off-line programming system automatically modifies and displays a modified current focus-dependent synthetic image in response to a modification of at least one of a) the current state of the user-alterable control elements, b) the current lens system representation of the first portion and c) the current state representation of the second portion.--

--51. The off-line programming system of claim 45, wherein:

the machine vision inspection system includes a graphical user interface including user-alterable control elements and an image display portion;

the user-alterable control elements and the image display portion of the off-line programming system are included in a substantially similar graphical user interface of the off-line programming system; and

the user-alterable control elements of the off-line programming system comprise a majority of the user-alterable control elements of the machine vision inspection system, such that that majority of the user-alterable control elements typically appear and operate substantially similarly in both the off-line programming system and the machine vision inspection system.--

--52. The off-line programming system of claim 45, wherein:

the hardware component simulation system further comprises a third portion operable to represent a current state of a lighting system of the machine vision inspection system;

the user-alterable control elements comprise at least one control element that affects the apparent lighting in the synthetic image representative of an image acquired by the machine vision inspection system; and

the off-line programming system is operable to generate the current focus-dependent synthetic image based on at least three of a current state of the user-alterable control elements, the current lens system representation of the first portion, the current state representation of the second portion and the current state representation of the third portion.--

--53. The off-line programming system of claim 52, wherein the representation of the current state of the lighting system of the machine vision inspection system includes a representation of the current state of at least one of a) a stage light and b) a coaxial light of the machine vision inspection system.--

--54. The off-line programming system of claim 45, wherein:

the user-alterable control elements are operable to input operation instructions which are substantially similar to the control instructions associated with the operations of corresponding user-alterable control elements of the machine vision inspection system;

the hardware component simulation system processes the input operation instructions in order to generate the current focus-dependent synthetic image; and

the hardware component simulation system generates the current focus-dependent synthetic image in an image data format which is substantially similar to an image data format associated with the actual camera image processing of the machine vision inspection system.--

--55. An off-line programming system for a machine vision inspection system, the off-line programming system comprising:

a user interface, comprising:

an image display portion usable to display a synthetic image representative of an image acquired by the machine vision inspection system, and

user-alterable control elements usable to input operation instructions representative of control instructions of the machine vision inspection system, the user-alterable control elements comprising at least one control element that affects the focus of the synthetic image representative of an image acquired by the machine vision inspection system and at least one control element which is operable to perform an image inspection operation on the synthetic image representative of an image acquired by the machine vision inspection system,

an input portion for receiving CAD data representative of at least a portion of at least one object inspectable by the machine vision inspection system;

a hardware component simulation system, comprising:

a first portion operable to represent at least a current lens system of the machine vision inspection system, including a limited depth of field of the lens system, and

a second portion operable to represent a current state of at least the relative position of the lens system and the portion of at least one object inspectable by the machine vision inspection system;

a communication interface portion connected to exchange control and data signals between the user interface and the hardware component simulation system; and

a control instruction generating portion,

wherein the off-line programming system is operable to:

generate a current focus-dependent synthetic image of at least the portion of at least one object inspectable by the machine vision inspection system including focus effects related to the limited depth of field of the lens system, based on at least two of a current state of the user-alterable control elements, the current lens system representation of the first portion and the current state representation of the second portion;

display the current focus-dependent synthetic image in the image

display portion of the user interface; and

operate the at least one control element which is operable to perform an image inspection operation based on the current focus-dependent synthetic image.--

--56. The off-line programming system of claim 55, wherein the off-line programming system is further operable to generate at least one control instruction usable in an inspection program for the at least one object, inspectable by the machine vision inspection system, based at least partially on the current state of the user-alterable control elements.--

--57. An off-line machine vision inspection simulation system for a machine vision inspection system that includes a graphical user interface comprising at least an image

display portion, user-alterable control elements comprising at least one control element that affects the focus of the synthetic image representative of an image acquired by the machine vision inspection system and at least one control element which is operable to perform an image inspection operation, the off-line machine vision inspection simulation system comprising:

a user interface substantially similar to the graphical user interface of the machine vision inspection system, comprising:

an image display portion usable to display a synthetic image representative of an image acquired by the machine vision inspection system; and

a plurality of user-alterable control elements usable to input operation instructions representative of control instructions of the machine vision inspection system, the user-alterable control elements comprising at least one control element that affects the focus of the synthetic image representative of an image acquired by the machine vision inspection system and at least one control element which is operable to perform an image inspection operation on the synthetic image representative of an image acquired by the machine vision inspection system,

wherein the user-alterable control elements comprise a majority of the user-alterable control elements of the machine vision inspection system such that that majority of the user-alterable control elements typically appear and operate substantially similarly in both the machine vision inspection simulation system and the machine vision inspection system;

an input portion for receiving CAD data representative of at least a portion of at least one object inspectable by the machine vision inspection system;

a hardware component simulation system, comprising:

a first portion operable to represent at least a current lens system of the machine vision inspection system, including a limited depth of field of the lens system, and

a second portion operable to represent a current state of at least the relative position of the lens system and the portion of at least one object inspectable by the machine vision inspection system; and

a communication interface portion connected to exchange control and data signals between the user interface and the hardware component simulation system,

wherein the machine vision inspection simulation system is operable to:

generate a current focus-dependent synthetic image of at least the portion of at least one object inspectable by the machine vision inspection system including focus effects related to the limited depth of field of the lens system, based on at least two of a current state of the user-alterable control elements, the current lens system representation of the first portion and the current state representation of the second portion;

display the current focus-dependent synthetic image in the image display portion of the user interface; and

operate at least one control element which is operable to perform an image inspection operation based on the current focus-dependent synthetic image.--

--58. The off-line machine vision inspection simulation system of claim 57, wherein the representation of at least a current lens system of the machine vision inspection system includes a representation of a plurality of lenses usable as the current lens system of the machine vision inspection system.--

--59. The off-line machine vision inspection simulation system of claim 57, wherein the machine vision inspection simulation system automatically modifies and displays a modified current focus-dependent synthetic image in response to a modification of at least one of a) the current state of the user-alterable control elements, b) the current lens system

representation of the first portion and c) the current state representation of the second portion.

--60. The off-line machine vision inspection simulation system of claim 57, wherein:

the hardware component simulation system further comprises a third portion operable to represent a current state of a lighting system of the machine vision inspection system;

the user-alterable control elements comprise at least one control element that affects the apparent lighting in the synthetic image representative of an image acquired by the machine vision inspection system; and

the machine vision inspection simulation system is operable to generate the current focus-dependent synthetic image based on at least three of a current state of the user-alterable control elements, the current lens system representation of the first portion, the current state representation of the second portion and the current state representation of the third portion.--

--61. The off-line machine vision inspection simulation system of claim 60, wherein the representation of a current state of a lighting system of the machine vision inspection system includes a representation of the current state of at least one of a) a stage light and b) a coaxial light of the machine vision inspection system.--

--62. The off-line machine vision inspection simulation system of claim 57 wherein: the user-alterable control elements are operable to input operation instructions which are substantially similar to the control instructions associated with the operations of corresponding user-alterable control elements of the machine vision inspection system;

the hardware component simulation system processes the input operation instructions in order to generate the current focus-dependent synthetic image; and



the hardware component simulation system generates the current focus-dependent synthetic image an image data format which is substantially similar to an image data format associated with the actual camera image processing of the machine vision inspection system.--

--63. The off-line machine vision inspection simulation system of claim 57 further comprising a control instruction generating portion, wherein the machine vision inspection simulation system is further operable to generate at least one control instruction usable in an inspection program for the at least one object inspectable by the machine vision inspection system, based at least partially on the current state of the user-alterable control elements.--

--64. The off-line machine vision inspection simulation system of claim 57, wherein the user interface of the machine vision inspection simulation system further comprises an external view representing the overall configuration of the machine vision inspection system corresponding to a current operating state of the machine vision inspection simulation system.--

--65. A method of off-line programming for a machine vision inspection system, the machine vision inspection system comprising:

a user interface, comprising:

an image display portion usable to display a synthetic image representative of an image acquired by the machine vision inspection system, and

user-alterable control elements usable to input operation instructions representative of control instructions of the machine vision inspection system, the user-alterable control elements comprising at least one control element that affects the focus of the synthetic image representative of an image acquired by the machine vision inspection system;

a hardware component simulation system, comprising:

a first portion operable to represent at least a current lens system of the machine vision inspection system, including a limited depth of field of the lens system, and

a second portion operable to represent a current state of at least the relative position of the lens system and the portion of at least one object inspectable by the machine vision inspection system; and

a communication interface portion connected to exchange control and data signals between the user interface and the hardware component simulation system;

the method comprising:

inputting CAD data representative of at least a portion of at least one object inspectable by the machine vision inspection system;

generating a current focus-dependent synthetic image of at least the portion of at least one object inspectable by the machine vision inspection system including focus effects related to the limited depth of field of the lens system, based on at least two of a current state of the user-alterable control elements, the current lens system representation of the first portion and the current state representation of the second portion;

displaying the current focus-dependent synthetic image in the image display portion of the user interface; and

generating at least one control instruction usable in an inspection program for the at least one object inspectable by the machine vision inspection system, based at least partially on the current state of the user-alterable control elements.--

--66. The method of claim 65, further comprising altering the at least one control element that affects the focus of the synthetic image to provide a new current state of at least that control element.--

--67. The method of claim 65, further comprising automatically modifying and displaying a modified current focus-dependent synthetic image in response to a modification

of at least one of a) the current state of the user-alterable control elements, b) the current lens system representation of the first portion and c) the current state representation of the second portion.--

--68. The method of claim 65, further comprising:

operating at least one control element which is operable to perform an image inspection operation based on the current focus-dependent synthetic image.--

--69. A method of off-line machine vision inspection system simulation for a machine vision inspection system that includes a graphical user interface comprising at least an image display portion, user-alterable control elements comprising at least one control element that affects the focus of the synthetic image representative of an image acquired by the machine vision inspection system and at least one control element which is operable to perform an image inspection operation, the off-line simulation system comprising:

a user interface substantially similar to the graphical user interface of the machine vision inspection system, comprising:

an image display portion usable to display a synthetic image representative of an image acquired by the machine vision inspection system,

a plurality of user-alterable control elements usable to input operation instructions representative of control instructions of the machine vision inspection system, the user-alterable control elements comprising at least one control element that affects the focus of the synthetic image representative of an image acquired by the machine vision inspection system and at least one control element which is operable to perform an image inspection operation,

wherein the user-alterable control elements of the machine vision inspection simulation system comprise a majority of the user-alterable control elements of the machine vision inspection system such that that majority of the user-alterable control

elements and image processing tools typically appear and operate substantially similarly in both the machine vision inspection simulation system and the machine vision inspection system;

a hardware component simulation system, comprising:

a first portion operable to represent at least a current lens system of the machine vision inspection system, including a limited depth of field of the lens system, and

a second portion operable to represent a current state of at least the relative position of the lens system and the portion of at least one object inspectable by the machine vision inspection system; and

a communication interface portion connected to exchange control and data signals between the user interface and the hardware component simulation system;

the method comprising:

inputting CAD data representative of at least a portion of at least one object inspectable by the machine vision inspection system;

generating a current focus-dependent synthetic image of at least the portion of at least one object inspectable by the machine vision inspection system including focus effects related to the limited depth of field of the lens system, based on at least two of a current state of the user-alterable control elements, the current lens system representation of the first portion and the current state representation of the second portion;

displaying the current focus-dependent synthetic image in the image display portion of the user interface; and

operating at least one control element which is operable to perform an image inspection operation based on the current focus-dependent synthetic image.--

--70. The method of f claim 69, further comprising automatically modifying and displaying a modified current focus-dependent synthetic image in response to a modification

of at least one of a) the current state of the user-alterable control elements, b) the current lens system representation of the first portion and c) the current state representation of the second portion.--

--71. The method of claim 69, wherein the hardware component simulation system further comprises a third portion operable to represent a current state of a lighting system of the machine vision inspection system and the user-alterable control elements comprise at least one control element that affects the apparent lighting in the synthetic image representative of an image acquired by the machine vision inspection system, and wherein generating the current focus-dependent synthetic image further comprises basing the current focus-dependent synthetic image on the current state representation of the third portion.--

--72. The method of claim 69, further comprising generating at least one control instruction usable in an inspection program for the at least one object inspectable by the machine vision inspection system, based at least partially on the current state of the user-alterable control elements.--